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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/602,291	06/24/2003	Elizabeth A. Dauch	NEC0252US	1241
33031	7590	07/13/2005	EXAMINER	
CAMPBELL STEPHENSON ASCOLESE, LLP			GURLEY, LYNNE ANN	
4807 SPICEWOOD SPRINGS RD.				
BLDG. 4, SUITE 201			ART UNIT	PAPER NUMBER
AUSTIN, TX 78759			2812	

DATE MAILED: 07/13/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/602,291

Applicant(s)

DAUCH ET AL.

Examiner

Lynne A. Gurley

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 20 April 2005.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-9 and 27-37 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-9 and 27-37 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.


LYNNE A. GURLEY

PRIMARY PATENT EXAMINER

TC 2800, AU 2812

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date 6/9/05.

- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

This Office Action is in response to the RCE with amendment with remarks, filed 4/20/05.

Currently, claims 1-9 and, new claims 27-37 are pending.

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 4/20/05 has been entered.

Specification

1. The specification has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

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Claims 27-31 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter, which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. Specifically, the claims include the limitation "liquid water having a pH less than neutral" (see claim 27). This new limitation is inclusive of extremely acidic ranges, instead of the "at neutral or 7" or "at or near neutral" or "slightly higher or lower than neutral" as disclosed in the specification, page 8.

3. Claims 27-31 are rejected under 35 U.S.C. 112, first paragraph, because the specification, while being enabling for a pH of the water being "at neutral or 7" or "at or near neutral" or "slightly higher or lower than neutral" as disclosed in the specification, page 8, does not reasonably provide enablement for a pH of the water being "less than neutral", which would include extremely acidic ranges. The specification does not enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make the invention commensurate in scope with these claims.

Claim Rejections - 35 USC § 102

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

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5. Claims 1, 5-9, 32, and 36-37 are rejected under 35 U.S.C. 102(b) as being anticipated by Muranaka et al. (US 6,358,329, dated on 3/19/02).

Muranaka shows the method as claimed in figures 1-5 and corresponding text, with W plug 2/3 (fig. 5) and conductive interconnect 5/5a. Embodiment 4 (column 4, lines 65- column 5, lines 1-14) shows a rinsing and/or washing method, where the rinsing or washing fluid may be ultrapure water or a solution for rinsing or a combination thereof. The rinsing step is 3 minutes or less. Therefore, the rinsing step, for less than 3 minutes, performed in ultrapure water, and followed by the washing step in a solution is shown. The water is neither degasified nor deionized.

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

7. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

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8. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

9. Claims 2-4, 27-31 and 33-35 are rejected under 35 U.S.C. 103(a) as being unpatentable over Muranaka et al. (US 6,358,329, dated 3/19/02) in view of Wang et al. (US 6,277,742, dated 8/21/01).

10. Muranaka shows the method substantially as claimed and as shows in the preceding paragraphs.

Muranaka lacks anticipation only in not teaching that 1) the liquid water is degasified and deionized; 2) the liquid water is deionized but not degasified; 3) the liquid water is degasified but not deionized; and 4) the liquid water has a pH less than neutral.

Wang teaches the removal of polymer residues from an interconnect overlying a W plug using an electrolytic solution which is either acidic or basic, in order to avoid corrosion of the overlying interconnect (column 1, lines 49-62; column 3, lines 50-67; column 3, lines 1- 9). The solution is purposefully not neutral so that corrosion does not damage the interconnect.

It would have been obvious to one of ordinary skill in the art to have used a liquid water having a pH less than neutral, in the method of Muranaka, with the motivation given by Wang in

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that the adjusted pH of the water, which is naturally an electrolyte, would prevent corrosion of the interconnect.

It would have also been obvious to have the liquid water be degasified and deionized; deionized but not degasified; or degasified but not deionized, in the method of Muranaka, with the motivation that changes or various combinations of the ionization and gasification of the liquid water would also effect the corrosion and the amount of charge which would effect the overall performance of the device.

11. Claims 1-9 and 27-37 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mautz et al. (US 5,476,816, dated 12/19/95) in view of Tsai et al. (US 6,410,417, dated 6/25/02) and further in view of the Admitted Prior Art (specification ,pages 2 [0009] – page 3 [0011]).

Mautz shows the method as claimed in Figures 3-6 and corresponding text as: forming a tungsten plug 32/31 in a dielectric layer 28; forming an electrically conductive interconnect line 41 on the dielectric layer after formation of the tungsten plug, wherein the tungsten plug is electrically connected to the electrically conductive interconnect line; contacting the electrically conductive interconnect line with liquid water after formation of the electrically conductive interconnect line; contacting the electrically conductive interconnect line with a solution after the electrically conductive interconnect line is contacted with the liquid water (column 6, lines 25-30, lines 45-62; column 7, lines 1-16); wherein the electrically conductive interconnect line is contacted with the liquid water for less than 120 minutes (claim 1; column 4, lines 2-27; column 5, lines 30-35, lines 53-56; column 6, lines 2-4, lines 28-29, lines 45-61; column 7, lines 2-17).

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The liquid water is deionized and degasified, and may contact the interconnect for 60-120 seconds or 45-120 seconds or 1-10 minutes (claims 1-2, and 7-8). The claimed interconnect materials are used (claim 9; column 4, lines 8-27). Liquid water inherently has a pH equal to 7, which is neutral (claim 6).

Mautz lacks anticipation only in not teaching, or explicitly teaching that: 1) the solution contacting the electrically conductive interconnect line removes residual polymer; 2) the liquid water is deionized but not degasified; 3) the liquid water is degasified but not deionized; and, 4) the liquid water is neither degasified nor deionized.

Tsai teaches, in figs. 1-4 and corresponding text, a similar tungsten plug and subsequent interconnect formation method. Emphasis is placed on the fact that Tsai teaches conventional processing for tungsten plug and interconnect devices and, the results of the processing steps, wherein after patterning the metal interconnect over the via plugs, the photoresist is removed by ashing, which often leaves a polymer residue on the surface of the wafer to be subsequently removed by a wet stripper (i.e., a solvent, alkaline, etc.) (column 1, lines 34-60). In addition to the polymer residue, the ashing process additionally results in an increase in the charge on the wafer (column 1, lines 45-48). The photoresist is removed by ashing with oxygen plasma and water vapor or water plasma, after patterning the interconnect. The water vapor or water plasma is used to reduce the amount of wafer charging and to protect the tungsten from erosion in case of misalignment as seen in fig. 4 (column 2, lines 1-10 and lines 50-61; column 3, lines 10-35).

The Admitted Prior Art teaches that the residual polymer residue on the interconnect is inherently formed and conventionally a problem to one of ordinary skill in the art [0010]; and,

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that conventionally an alkaline or basic solution (pH greater than 7) or, and acidic solution (pH less than 7) is used to eradicate the residue [0011].

It would have been obvious to one of ordinary skill in the art to have incorporated, in the method of Mautz, a solution contacting the electrically conductive interconnect line to remove residual polymer (which is inherently present on the interconnect as a result of conventional patterning, as taught by the Admitted Prior Art), as taught in the method of Tsai, with the motivation that Tsai teaches that the solution removes the polymer residue resulting from a conventional resist ashing process, such as the conventional ashing process shown in Mautz. Additionally, one of ordinary skill in the art would find motivation to incorporate the polymer removing solution, taught in Tsai, within the framework of the liquid water and solution exposure steps in Mautz, since Mautz teaches that liquid water rinsing is performed before the exposure of the substrate to a solution which removes contaminants such as mobile ions on the substrate (column 4, lines 66-67; column 5, lines 1-3 and lines 23-67; column 6, lines 1-3). The residual polymer is considered to one of ordinary skill in the art to be a form of contaminant and, the solvent, which Mautz uses, removes the contaminants and contains alcohols (column 5, lines 40-51) which are naturally basic and alkaline, such as the polymer removing solution exemplified in Tsai. In general, Tsai makes it clear that the polymer removal step is necessary as a separate step from the ashing step (column 3, lines 40-43). The ashing step is used to reduce the charge on the wafer in Tsai, just as the solvent exposure, in the wafer cleaning step, is used in part to reduce the wafer charge in Mautz. The two processes are compatible because they both seek to reduce the wafer charge in similar tungsten plug/interconnect processes and taken as a whole, both teach and acknowledge that solutions used after the ashing process are necessary to

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clean the substrate of contaminants, to remove charges on the wafer and to remove residual polymer. To further add a step to the process of Mautz to remove the polymer residue after the ashing step would be obvious in addition to removing the harmful charge on the wafer.

It would have also been obvious to one of ordinary skill in the art to have modified the properties of the water in the method of Mautz, pertaining to ionization and degasification and slightly less or more pH, with consideration for possible tungsten erosion and misalignment as taught by Tsai and as taught by the Admitted Prior Art, which shows that both acidic and basic/alkaline solutions benefit the polymer removal and, with the motivation that changing these parameters would offer additional control in the amount of charged particles desired on the surface of the interconnect, especially since Tsai teaches that the water vapor or water plasma is useful for decreasing the wafer charge due to the ashing step.

Response to Arguments

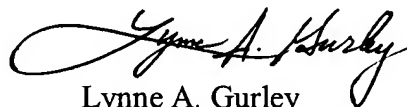
12. Applicant's arguments filed 4/20/05 have been fully considered but they are not persuasive. In response to Applicant's remarks, pages 5-6, Mautz teaches that the residual polymer on the insulating layer is removed. Mautz teaches that a residue results from the etching step 9column 10, lines 62-67; column 11, lines 1-12). The residual polymer is a result of the etching step to pattern the interconnect, and the Admitted Prior Art further confirms that this residue is also present on the interconnect.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lynne A. Gurley whose telephone number is 571-272-1670. The examiner can normally be reached on M-F 7:30-4:00.

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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Lebentritt can be reached on 571-272-1873. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



Lynne A. Gurley
Primary Patent Examiner
TC 2800, Art Unit 2812

LAG
July 9, 2005